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THE ELECTRIC LIGHT IN ECLIPSE.

THE electric light, after an unprecedented outburst during the latter part of last year, has of late begun to wane in public interest. The inevitable reaction has set in, and even its former admirers are turning a severe eye upon it. We are told that its violet rays give the countenance a cadaverous hue, that it vitiates the air not only with ozone (which is a wholesome thing by the way), but with carbonic and nitric acids, and that white hot sparks fly from it with dangerous impetus. The impossibility of subdividing it has been drummed into our ears until it has become that most pernicious of all kinds of cant, namely, scientific cant; and the hopeless cost of producing it has been harped upon incessantly.

The fact that Mr. Edison has neither given the public exhibition of his light, which was promised, nor authorised accounts of it as yet; and the failure of the Jablochkoff system at Billingsgate Market and Westgate-on-Sea, are, perhaps, the leading causes of this reaction. Some people have begun to think that Edison is finding out that he cannot perform what he undertook; but the wiser plan is at least to wait until his method is fully disclosed. The Jablochkoff system has been fairly tried on its own merits at Westgate-on-Sea, at the instance of Mr. E. F. Davis, a landowner of that place, and pronounced a failure in point of cost as compared with gas. Six Jablochkoff lamps were fitted up in the Sea Road, 80 feet apart, each containing four candles which burned an hour each. The current was supplied by a six light Gramme machine, driven by a 10 H.P. (nominal) portable engine, made by Messrs. Garrett & Co. The current was divided into two circuits, each of which included three lamps. One attendant was required for the engine and one for the machine and lamps. The experiments began on Dec. 2nd, and were kept up for 24 nights for four hours each night, thus giving a total of 96 hours. On eight several occasions candles went out, perhaps because of the carbons being faulty; and each time this took place both the others in the same circuit were extinguished. The working expenses for 24 days amounted to £40 9s. 4d., and this sum includes fuel, water, oil, 586 candles at 8d. each, and the wages of the two attendants. Each lamp gave a light equal to 197 sperm candles, and therefore the illuminating power of the whole six came to 1,182 candles. To produce the same amount of light by Westgate gas 107½ gas jets, burning 5 c. ft. per hour, which at the Westgate rate of 6s. 6d. per 1000 c. ft. would cost in all £16 15s. 4d. for the 96 hours. Calculated at the London price of 3s. 6d. per 1000 c. ft., the total cost would only have been £7 18s. 9d. for gas, as against the £40 9s. 4d. for electricity. On this basis the working expenses of the six electric lights for a year of 4,327 lighting hours, is given by Messrs. Bennet and Valon, the engineers, as £1,576 0s. 8d., or about 1s. 2½d. per light per hour, including the interest at 10 per cent on the first outlay, for buildings, plant, &c., which is put down at £1,522. This estimate is exclusive of interest on working capital, and depreciation of buildings and cables. The cost of supplying Westgate with gas for the same time, including lighting, cleaning, and repairing would only be £825 14s. 10d. For London it would be very much less, only £427 13s. 3d. for gas, as against £1,576 0s. 8d. We thus gather from the very valuable and expensive experiment of Mr. Davis, and the clear report of his engineers, that the Jablochkoff system is between three and four times more expensive than London gas lighting.

Luckily, however, the fate of electric lighting does not rest upon the Jablochkoff system, although the failure of the latter will for a time throw discredit on all other plans. Jablochkoff's system is known to be at least twice as expensive as other systems now in vogue, and far more complicated. If it is found wanting, other plans must be tried instead, before the question of gas *versus* electricity can be fairly settled as it stands. The electric light has a double field. It can compete with gas in the lighting of streets and open spaces, and it can be used for special purposes which gas is unsuited to. For the former places the relative costs will determine whether it will be preferred to gas or not; for the latter places its introduction is assured irrespective of the cost of gas, for no light can vie with it for the purposes in view. Now as regards open spaces where a few large lights are used, it is well to bear in mind that Mr. Schwendler finds the electric light from a single Serrin source to be 50 times cheaper than gaslight, a figure which allows a wide margin for loss by subdivision for street lighting.

The amount of contradictory assertions made as regards the science of the electric light serve to show that it is dangerous to dogmatise as yet upon the subject. Even the electric properties of the arc are not yet fully understood, and still less are its photometric properties. It is ever the case that those who lack the necessary inspiration to conquer

a difficulty, are the first to preach its impossibility. Prof. Ayrton has shown that the difficulty of subdividing the electric light is not an electrical one but is due to the fact that the amount of light produced is not directly proportional to the amount of heat produced. What then if a means be found of making the light proportional to the heat produced? Again, Mr. W. H. Preece has shewn [see page 59.] that with incandescent iridium, a temperature can be reached at which the light given out is equal to that from the voltaic arc itself. Iridium is very costly now, but if there be a demand for it, will it not soon be cheapened? Dynamo-electric machines are undergoing constant improvement. Carbon-electrodes are recognised as defective and will either be speedily bettered or abandoned altogether. Many minds are concentrated on the problem of electric lighting, and the prizes are great. So that it would be unwise to assume that the eclipse which the electric light is now suffering will be a lasting one.

A TELEGRAPH TO THE CAPE.

THE recent disaster to our arms inflicted by the Zulus renders it imperative that telegraphic communication should be speedily established with the Cape Colonies. The subject was brought to the notice of Sir Michael Hicks-Beach on February 12 by a deputation, headed by Sir J. Lubbock and Sir H. Barkly. These gentlemen advocated the construction of an overland line from Egypt to Pretoria *via* Zanzibar, the pet scheme of the colonists, and requested a Government subsidy to aid in the work, which they estimated to cost £750,000. The Colonial Secretary replied that the Government was prepared, with the Colonial Parliament, to subsidise a company undertaking the work; and that he believed at present a cable more feasible than a land-line, though the latter might be more advantageous when once established. Before deciding in the matter he should, however, require a definite estimate of the time and money required for making a land-line. It is to be hoped that this will speedily be furnished him, and that, whether the line be overland or submarine, and the latter indeed seems to us the most feasible at this time, it will now be realised.

BRIGHT'S ELECTRICAL FIRE INDICATOR.

THE electrical fire alarm systems so common in American towns, have never been received with much favour in England. Whether this arises from mere apathy or from the conservatism, for which Local Government Boards are notorious, it is difficult to say, but the fact remains that although many attempts have been made, but very little, if any, progress has resulted towards introducing any system of electrical or other fire alarms. It is not that such systems have not been shown to be practicable, for many have been exhibited and partially worked with success, but unfortunately, we believe, in no case, where the apparatus has been fitted, has an opportunity arisen for practically demonstrating the utility of the inventions, and for this reason possibly the schemes have been allowed to fall into oblivion.

One of the most recent inventions for effecting the object in view, is that of Mr. E. B. Bright, whose system has recently been fitted up, and had a practical trial, in Glasgow. As this system possesses some decided points of novelty over those hitherto invented, it merits a description.

The chief point of novelty in the apparatus consists in the employment of artificial electrical measures of resistance (or rheostats) for the purpose of making known the locality of the fire; such artificial measures of electrical resistance being used in combination with thermostats or appliances for closing or opening or making a variation in an electrical circuit or circuits by such fire.

The following is a description of the apparatus:—

Fig. 1 is a section, and fig. 2 a side view of a thermostat, consisting of a metallic box inside of which is fixed a curved band *c*, formed of two metals, such as platinum and brass, which expand unequally under the influence of heat. Opposite the end of the band *c*, is an insulated screw *d*, which can be so adjusted that the addition of any given amount of heat will, by its effect upon the band, bring the end of the band *c* into contact with the end of the screw terminal *d*. The terminal *e* is connected with the metallic box, and therefore with the curved band *c*.

Fig. 3 is a general plan, shewing the apparatus employed at the fire brigade station or other place to which a warning is to be given, and also a diagram of the electrical circuits in connection with the thermostats and rheostats by which the locality whence the warning proceeds is indicated.

Fig. 4 is a side view of the indicating apparatus at the fire brigade station or other place to which a warning is to be given.

The series of circles marked with numbers varying from 5 to 15 included by the bracket *f*, represents a number of rheostats placed in the various buildings or places from which an alarm may be given. They are connected together by a line wire *g*, extending to the fire brigade station, as shewn by the diagram, which wire is there joined to one side of the differential coil *h*, and thence through the alarum *i* to one pole of the battery *j*. The same pole of the battery *j* is also connected through the alarum to the other side of the differential coil *h*, and thence to the end of a series of rheostats fixed round a circle in the indicating apparatus at the station, which are also marked on the plan, with numbers varying from 5 to 15, indicating electrical resistances corresponding with those of the rheostats included in the bracket *f*, before described.

By means of the handle *k* the arm *l* with a spring *m* can be moved over a series of metallic plates *n*, *n*,

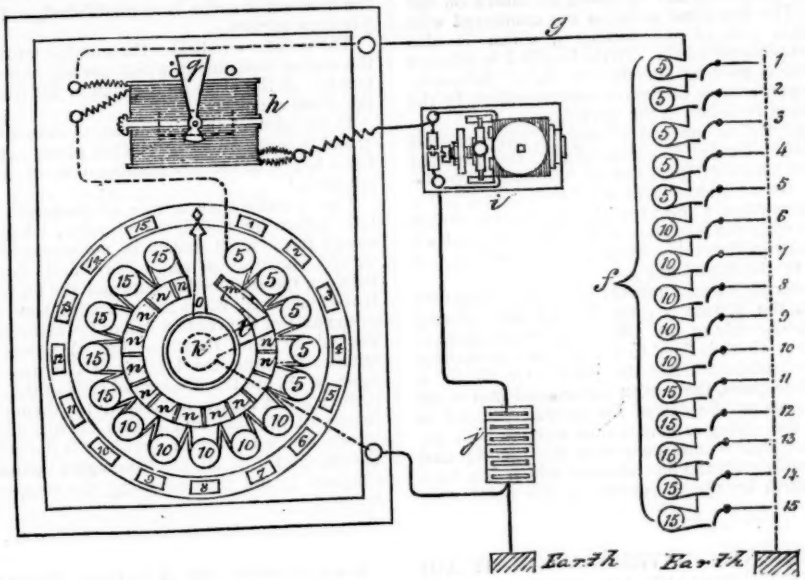


FIG. 3.

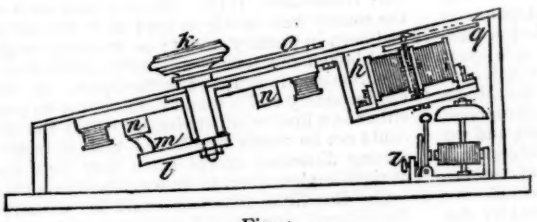


Fig. 4.

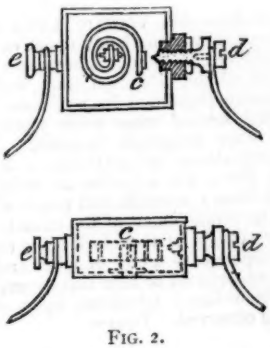


FIG. 1.

FIG. 2.

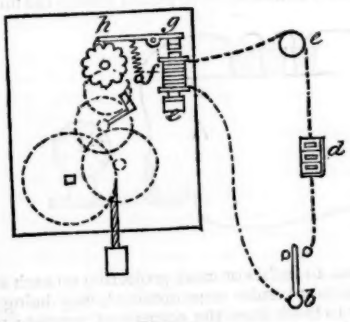


FIG. 5.

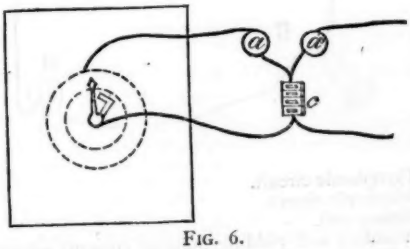


FIG. 6.

which are insulated from each other, and connected consecutively with the rheostats, as shown on the plan. The arm *l* and spring *m* are connected with the other pole of the battery *j*, which is also connected to the earth. To the handle *k* is attached a pointer *o*, moving outside the dial of the instrument over a circle of figures corresponding to the number of rheostats in the circuit.

Connected to one end of each of the rheostats included in bracket *f*, is a thermostat, the insulated screw of which *d* (figs. 1 and 2), is connected to the earth. On an undue increase of heat taking place, the band *c* (figs. 1 and 2) of the thermostat makes contact with the insulated screw *d* (figs. 1 and 2), and thus completes the circuit with the battery *j*, as shewn by the dotted line *p*.

The electric current from the battery *j* passing thus through the alarum *i* rings it, and also passing through one side of the differential coil *h*, deflects the disc *q*, which is fixed to the axle of a permanent magnet contained within the coil *h*. On the alarm being thus given, the person summoned moves the handle *k* round the dial of the instrument, and as soon as the spring *m* comes into contact with the particular plate *n* connected with the rheostat that corresponds with the line rheostat which has been put to earth by the thermostat at the point from which the alarm is given, the electrical balance of the differential coil *h* is re-established, and the disc *q* returns to zero.

The pointer *o* indicates the number on the dial of the station instrument which corresponds with the number of the place on the station list from which the alarm emanates.

In the plan of the apparatus, as drawn in figs. 3, 4, and 5, only fifteen protected places are shewn, but a larger or smaller number can, of course, be connected.

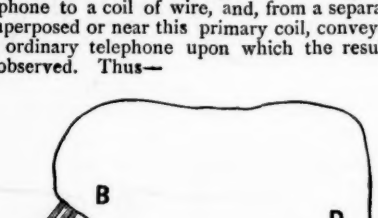
Figs. 5 and 6 shew a train of clockwork brought into action by a differential relay, which moves round the contact maker in connection with the station rheostats in case of fire, until the balance between the station rheostats and the line rheostats is re-established, when the indicating hand attached to the axle of the contact maker (as in the apparatus worked by hand shown at fig. 3) points to the number showing the locality of the fire. In this figure *a*, a^1, are the differential coils of the relay; *b* is the contact maker influenced by them; *c* is the battery of the line and station circuit, and *d* the battery of the local relay circuit; *e* is the coil of the alarum, and *f* is an electro-magnet actuating an armature *g*, and thus releasing the escapement or detent h^1.

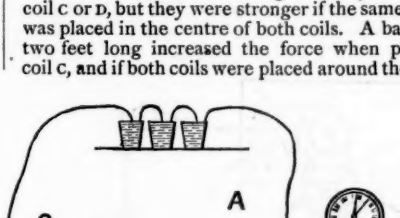
EXPERIMENTAL INVESTIGATION BY AID OF THE TELEPHONE AND MICROPHONE.

By PROF. D. E. HUGHES.

INDUCTION BY VOLTAIC CURRENTS.—It is well known how remarkably sensitive the telephone is to induced currents. They were remarked at once upon all the telegraph lines, and have in a great measure prevented its use upon lines which contained several other wires worked by the Morse or other telegraph systems. The microphone greatly aids us in researches of this nature, and we will cite a few experiments which are interesting, both from a scientific and practical point of view.

The arrangement of the circuits were as follows: The sounds of the clock being transmitted by the microphone to a coil of wire, and, from a separate coil superposed or near this primary coil, conveyed to an ordinary telephone upon which the results were observed. Thus—





A Microphonic circuit.
B Telephonic circuit.
C Primary coil.
D Secondary coil yielding induced currents which were listened to in the telephone B.

I.—Two similar coils, of 60 turns, No. 30 covered copper wire, and 2 inches diameter, the one being used at C for primary, the second at D for secondary. Sounds and speech could be clearly heard in the telephone with a perfection of timbre very remarkable. If the coils were near each other, the sounds were nearly as loud as if the telephone had been in primary circuit; on gradually removing it, although the sounds gradually diminished, they could be clearly heard 12 inches apart. In moving the secondary coil D round C, there was no position either in a line or otherwise, in which the sounds could not be clearly heard, and that at really surprising distances, except when they were exactly at right angles, when there was absolute silence.

II.—But little difference could be observed in the induced currents if a magnet was placed in the coil C or D, but they were stronger if the same magnet was placed in the centre of both coils. A bar of iron two feet long increased the force when placed in coil C, and if both coils were placed around the middle of this bar, 10 inches or more projecting on each side, the maximum results were obtained, they being far superior to those from the permanent magnet; thus with induced currents a constant magnetic field induced by a natural magnet plays but little part;

the electro-magnetic changes taking place in a bar of iron have important and easily recognisable effects.

III.—The coils C and D being held firmly on stands at a fixed distance of 4 inches. No appreciable difference could be observed by the interposition of any non-conductor, such as wood, gutta-percha, &c.; but of conductors there was a difference, copper being the most marked, equal to six plates of iron of same dimensions; but it was remarkable how little difference this made, for, with fifteen interposed sheets of iron, the sound still had about one-quarter of its original force, and when we remember that on each of these plates strong induced currents were produced, it was remarkable that there should still have remained a surplus force to produce the clear and distinct tones by the induced currents produced after all this work.

IV.—Coils being as above, but 5 inches apart, so as to allow of the introduction between them of a half-pound reel of No. 30 covered copper wire, and ends of this wire left open, no appreciable diminution of sound was remarked; but the instant the circuit was closed by joining the two ends of the half-pound reel the sounds were diminished so as to be hardly audible: the telephone here verifying a fact long well known of the influence of closed circuits in cutting off the induced currents; but that the effect is in all cases proved to be but partial was by the introduction of one or two coils similar to C and D between them having closed circuits. The screening effect of these coils was hardly perceptible.

V.—Four coils were constructed all of exactly similar wire and length. Two were of a flat wide surface, 3 inches diameter, ½ inch high. The other two were formed after the ordinary helix pattern of an electro-magnet, 1 inch diameter, 2 inches high. It was found that the flat coils (used by Henry, Hare, and Matteuci for induced currents) were far more powerful than the two ordinary helices placed at any distance from each other; the flat coils were fully three times more powerful. One of these electro-magnetic helices was then unwound and rewound over the second, similar to the arrangement in the Ruhmkorff coil, and compared with the flat coils resting on each other, the winding of the coil *à la Ruhmkorff*, had decidedly improved their force, but still the flat coils showed a marked superiority, being about one-half stronger, as near as it was possible to judge from estimation by sound.

VI.—If we change the conditions of the last Experiment, and replace the coil C by an ordinary telephone, placing the coil D below the diaphragm, so that its ordinary coil will be in the centre of this coil, we shall then hear loud tones in both telephones, the first in the primary, the second in the secondary, or induced circuit, and very little difference will be perceived between them. By this system, a double telephone can be used, giving double the effect of a single one, and that without introducing more resistance in the primary circuit than a single telephone, a very remarkable advantage where two telephones are used, and what is still more remarkable is, that if we withdraw the magnet and coil of the primary circuit, so that it is no longer in perfect adjustment, giving feeble tones, the second telephone worked by the secondary coil stationary near diaphragm, gives out almost as loud tones as originally, thus the secondary circuit then becomes far the loudest and clearest.

VII.—We have already shown that we can, by the induction of one coil near the other, hear distinctly all the sounds of the microphonic circuit. If now, instead of using one primary coil and one microphonic circuit, we use two or more distinct primary circuits, each connected with its special microphone, and these primary coils placed near one another, the single secondary coil placed at a distance intermediary from these separate primary coils; we hear then in the telephone not only the clock of the first primary, but in addition, say, articulate sounds on second primary, and singing or music on third. We have here a compound induction of three distinct undulatory waves of primary resolved into one undulatory wave, giving us at the same time the effect of the whole. We might thus have a piano in one room, singing without words in another, and words only in the third, and these, not in any way directly connected to telephone line, would by simple induction give us the effect of a song with words and piano accompaniment.

VIII.—Having seen by numerous experiments that the induced currents act at great distances, we thought that by simply placing a diaphragm in a high magnetic field we should hear distinctly from the diaphragm, notwithstanding that the coil was separated several inches from it. To this end we took out the coil of an ordinary telephone, leaving simply the magnet and diaphragm. The magnet was carefully adjusted near diaphragm, and the coil C of the microphone circuit held near this skeleton telephone. Loud sounds could be clearly heard when coil near telephone, no matter in what position or direction; the coil might be held several inches distant, and still the sounds were audible. If we withdrew the magnet no sounds were audible, however near the coil might be; but on re-adjusting magnet, by careful listening, the sounds could be heard when coil was 12 inches distant, and on placing the skeleton telephone to one ear and the coil to the other, clear sounds could be heard. On removing the telephone, which was not in any circuit, and listening to the coil which was, and from which the force proceeded, no sounds whatever could be heard. On replacing the telephone, the clear and comparatively loud tones at once became audible. Thus the electro-magnetic induction passed through one ear unperceived to put the diaphragm beside the second telephone in motion, by means of which sonorous waves were at once produced which that ear could appreciate.

THE CRITERIA OF THE ELECTRIC LIGHT.

We extract the following passages from a very instructive lecture to the Royal United Service Institution, by Mr. W. H. Preece:—

Heat and light are identical in character, though different in degree; and whenever solid matter has imparted to it motion of a very high intensity—in other words, when solid matter is raised to a very high temperature—it becomes luminous. The amount of light is dependent upon the height of this temperature; and it is a very remarkable fact that all solid bodies becomes self-luminous at the same temperature.

This was determined by Daniell to be 980°, by Wedgewood 947°, by Draper 977°; so that we may approximately assume the temperature at which bodies begin to show a dull light to be 1,000°. The intensity of light, however, increases in a greater ratio than the temperature. For instance, platinum at 2,600° emits forty times more light than at 1,900°. Bodies when raised to incandescence pass through all stages of the spectrum; as the temperature increases, so does the refrangibility of the rays of light. Thus, when a body is at a temperature of—

Temperature	
°	
250	it may be called warm.
500	„ „ hot.
1,000	we have the red rays,
1,200	„ „ orange rays.
1,300	„ „ yellow rays.
1,500	„ „ blue rays.
1,700	„ „ indigo rays.
2,000	„ „ violet rays.

So that any body raised to a temperature above 2,000° will give us all the rays of the sun. Inversely, the spectroscope may thus be enabled to tell us the temperature of the different lights, and it is, perhaps, because some lights do not exceed 1,300° that we lose all those rays beyond the yellow. . . .

Dr. Tyndall has shown that the visible rays of an incandescent wire bear to the invisible rays a much smaller proportion than in the arc, and it is generally assumed that for the same current the arc will give at least 2½ times greater light than an incandescent wire; in fact, Dr. Tyndall's figures are as follows:—

	Visible rays.		Invisible rays.
Gas	1	to	24
Incandescent wire	1	„	23
The arc	1	„	9

* * *

The requirements of a good electric lamp are, first, intense brilliancy; secondly, great steadiness; thirdly, duration. The Serrin lamp has the first kind of excellence; all those lamps based on incandescence excel in the second respect: the Wallace-Farmer light is the only one that attains the third point. The Rapieff is perhaps that form which up to the present most nearly combines the three requisites, but in reality no lamp has yet been introduced which fulfils all three requirements.

The objections to the use of the electric light are:—

1. The deep shadows it throws.

2. The indifferent carbon that has hitherto been manufactured for the purpose, which leads to unpleasant sounds, to great variation in the intensity of the light, and to waste.

3. The difficulty in distributing the light itself. It is so intense and confined to so small a space that it does not lend itself to distribution like the gas flame which occupies a considerable space.

4. The unsteadiness of the light due to variations in the speed of the engine employed in driving the dynamo machine. There is another cause of variation in the electric arc, and that is, the variation in the resistance of the arc itself, for it has been clearly demonstrated by experiments both in America and in England, that the resistance of the arc varies as the resistances in circuit vary. The following table will show this:—

Current in Webers.	Light candles.	Resistance of arc. Ohms.
10	440	2·77
16·5	705	1·25
21·5	900	1·67
30·12	1230	·54

The light in the arc varies directly as the current, and not as the square of the current as is generally assumed.

Now, in the case of light raised by incandescence, the light will increase as the square of the current. It follows that if in the one case—viz., the arc, the light increases as the current only, and in the other case—viz., incandescence, it increases as the square of the current, a point is reached when the light produced by incandescence will equal that produced by the arc. The difficulty in reaching that point is the difficulty in obtaining a conductor with a sufficiently high point of fusion to resist the effect of powerful currents. Iridium is the only metal that is known to do this, and iridium is too scarce and too dear to be used for the purpose.

The multiplication of the light by Gramme's machine upon the Thames Embankment must not be taken as the solution of the problem of the subdivision of the light. Theory shows unmistakably that to produce the greatest effect we must have only one machine to produce only one light. We know from absolute measurements that such a machine can be used to produce a light of 14,880 candles, and it is possible to produce 1,254 candles per horse-power. But the moment that we attempt to multiply the number of lights in circuit this power diminishes, so that we have on the Embankment lamps giving us a light of scarcely more than 100 candles. The light of the Rapieff lamp in the *Times* office appears to be about 600 candle power, and the Wallace light is equal to 800 candle power. In these two instances six lights are used in one circuit, but we have not here the subdivision of the light, we have, on the contrary, the multiplication of the light, produced by the increased speed of the engine due to the insertion of additional lamps. It is, however, easily shown that in a circuit where the electro-motive force is constant, and we insert additional lamps, then when these lamps are joined up in one circuit, *i.e.*, in series, the light varies inversely as the square of the number of lamps in circuit, and when joined up, as in multiple arc the light diminishes as the cube of the number inserted. Hence the subdivision of the light is an absolute *ignis fatuus*. In the first place no machine has yet been produced which is competent or capable of lighting over 20 lamps; secondly, no conductor is known but copper competent to convey the current required to light these lamps, and copper is an expensive material. Thirdly, no electric light has yet been produced which combines all the criteria needed for a good light.

RAPIEFF'S THREE-CARBON NEW REGULATOR LAMP.

SINCE the Rapieff's four-carbon regulator electric lamp was described in THE TELEGRAPHIC JOURNAL for November 1st, 1878, M. Rapieff has made some important improvements in his ingenious apparatus. He has constructed a new three-carbon regulator lamp, designed for lighting up the machine and composing rooms of the *Times* office.

An objectionable feature in all electric lamps, and especially "candles," now in use, is that the bottom part of those apparatus containing the mechanism of the regulator or the holders for the "candle" is opaque, and being also brought into such close proximity with the voltaic arc, absorbs a great portion of the light immediately below the apparatus, that is, just where the light is most needed. In this respect the electric light has hitherto been very

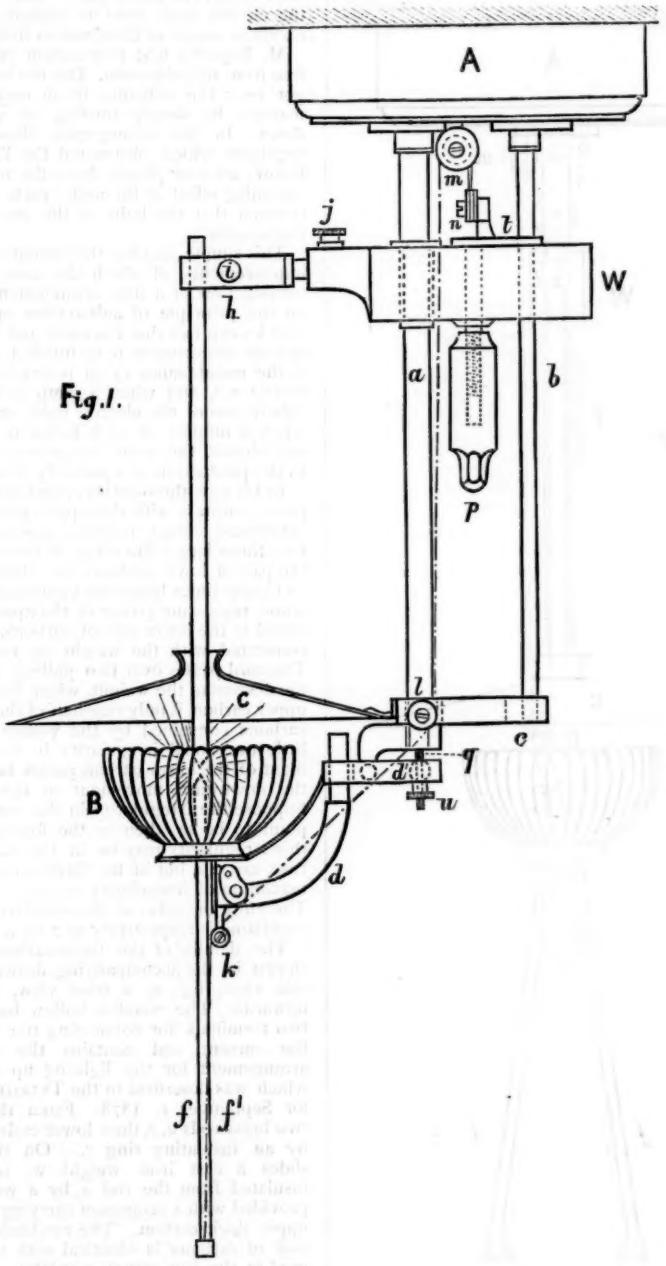


Fig. 1.

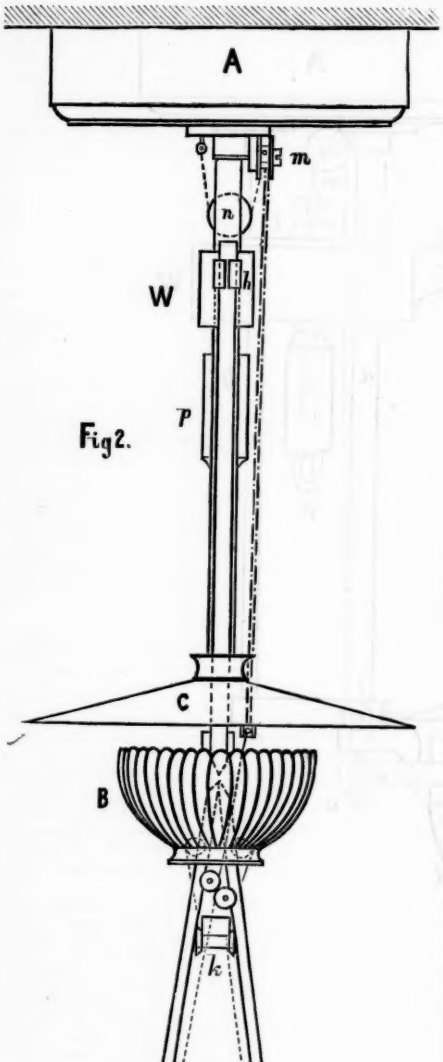


Fig 2.

much behind gas, especially when compared with such burners as the elegant "sun" light. And yet the electric light, from its intensity, ought to be an excellent means of illumination from ceilings.

M. Rapieff's first four-carbon regulator was not free from this objection. But the inventor has since got over the difficulty in an easy and successful manner, by simply turning his regulator upside down. In this arrangement those parts of his regulator which obstructed the light immediately below, are now placed above the reflector, and the screening effect of the under parts of the lamp is so reduced that the light of the arc is shed equably underneath.

This simple idea led the inventor to some other improvements, of which the most important is the introduction of a new arrangement which is based on the principle of subdivision of errors. It is a well-known fact that the chief and by far the most delicate requirement to be fulfilled in each regulator is the maintenance of an invariable length for the voltaic arc, and when a lamp is intended for the subdivision of the electric light, or, in other words, when a number of such lamps are to be lighted in one circuit, this point becomes still more essential to the production of a perfectly steady light.

In his new three-carbon regulator, M. Rapieff dispenses entirely with the upper pair of carbons, and substitutes a single positive carbon whose section is four times larger than that of the section of one of the pair of lower carbons for alternating currents, and eight times larger for continuous currents. The whole regulating power of the apparatus is concentrated in the lower pair of carbons, their ends being connected with the weight by two strong cords. The cord passes over two pulleys, so arranged that the descent of the weight, which likewise carries the upper carbon, is only one-half of the length of lower carbons consumed by the voltaic arc. Thus any little occasional irregularity in the upward movement of the lower carbon points becomes halved in the downward movement of the upper carbon. Suppose the irregularity in the motion of a single point to be s; then in the four-carbon regulator this irregularity may be in the most unfavourable case, say, 2 s, but in the three-carbon regulator this maximum of irregularity is only $s + 0{\cdot}5\ s$ or $1{\cdot}5\ s$. Therefore the ratio of the sensitiveness of the two regulators is respectively as 2 to 3.

The details of the three-carbon regulators are shown in the accompanying drawings. Fig. 1 is a side view, fig. 2, a front view, as seen looking upwards. The wooden hollow base A carries the two terminals for connecting the wires conveying the current, and contains the electro-magnetic arrangement for the lighting up of the apparatus which was described in the TELEGRAPHIC JOURNAL, for September 1, 1878. From this base descend two brass rods a, b, their lower ends being connected by an insulating ring c. On these rods there slides a cast iron weight W, of about 6 lbs., insulated from the rod a, by a wooden bush, and provided with a projection carrying the clips for the upper thick carbon. The mechanism of the lower pair of carbons is identical with the arrangement used in the four-carbon regulator. A brass piece d joins the lower carbon holder to the lever d', which is actuated by the electro-magnet by means of a rod g. The weight is suspended on two cords,

their ends being respectively fixed to the base *a*, and the other ends to the carbons *f* and *f'*, the cords passing over the pulleys *k*, *l*, *m* and *n*, which are so arranged, that the movement of the weight is half the speed of that of the lower two carbons. To prevent the fall of the weight by accident, a little automatic brake (not shown in the figure) is adjusted, which is always loose when the weight is suspended, but begins to press against the brass stem at the moment when by some mishap, or in recharging the carbons, the cords are relaxed, and thus stays the weight. The length of the voltaic arc may be adjusted by two screws or nuts *p* and *u*. The nut *u* simply lengthens or shortens the rod *q*, which connects the lever *d*, with the armature of the electro-magnet, and so raises or lowers the lower carbon holder. By means of the nut *p*, the upper carbon may be raised or lowered as can be seen by the figure. The pulley *n* is fixed to a cross-bar provided with a rod sliding in the weight W. The end of the rod is threaded and fitted with a cylindrical nut *p*, which thus actually supports the whole weight. By screwing the nut up or down, the weight respectively rises or descends, and with it the upper carbon *g*.

The whole apparatus is more compact than the four-carbon regulator, and no part of it is subjected to the injurious influence of the heat generated. A large reflector C is added to project the whole light below, and a saucer-shaped opal shade B softens the dazzling brilliancy of the voltaic arc to an agreeable, yet bright light. A large portion of the light is unshaded, and, reaching the walls is reflected back into the room, thus adding to the general illumination and preventing the great loss of light occasioned by the use of opal globes. Lastly the new regulator is much better adapted for being fitted up as an ornamental lamp.

THEILER'S NEW SOUNDER.

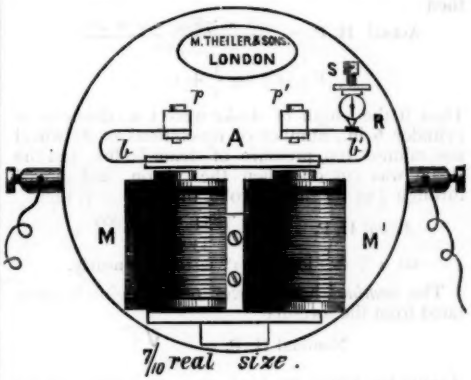
MESSRS. THEILER & SONS have lately designed and are now making a very simple, but highly efficient, form of sounder which is free from the objections which have been raised against the ordinary form of instrument. In the new pattern the dash is readily distinguished from the dot by the longer *duration* of the sound, the latter resembling a bugle note which can be made loud or soft at will.

The fig. shows a plan of this extremely simple instrument.

The vibrating reed A consists of an iron armature attached to two flat springs *b b'*, which are bent into U shape (to save space), and which are firmly fixed to the pillars *p p'*. The electro-magnet M M' is planted as close as possible to the armature A without actually touching it. The adjustable contact S impinges on the spring *b* at R, but breaks connection as soon as A is attracted by M M'. In order to secure the parts firmly in their place the whole is mounted on a hollow metal base, to which a bottom of thin Swiss pine is screwed, thereby increasing the sound very considerably.

A single Fuller's cell is sufficient to work this sounder satisfactorily, and Messrs. Theiler have no doubt of being able to make a sounder on the same principle which will work with the direct line current.

Theiler's sounder differs from similar acoustic apparatus in having no *free* end to the vibrating



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reed; the sound, therefore, starts and ceases the *very instant* the key makes and breaks contact.

We have had an opportunity of examining one of these instruments and can testify to their efficiency.

ENGINES FOR WORKING ELECTRIC LIGHT MACHINES.

I.

Messrs. Robey and Co.'s Patent Fixed Engine.

THE question of the engine power required for driving dynamo-machines employed in producing the electric light has received considerable attention lately, and many engineering firms have manufactured engines which are remarkably well adapted for the purpose.

Before proceeding to describe any of these engines, we would draw attention to the cause of the large discrepancies which exist when comparisons are made from the popular accounts of electric light trials, the discrepancies we mean as regards the horse-power required to produce the light. This almost entirely arises from *nominal* horse-power being confounded with *actual* or *indicated* horse-power. Now there is, almost always, a very wide difference between these quantities. The *actual* horse-power is often 4 or 5 times the *nominal* horse-power. As the former quantity is the only true index of the work done in producing the light, it should always be the one employed in making calculations for comparisons. The *actual* horse-

power is calculated with great facility. Thus, if we have given

Length of stroke in feet $= l$;
Diameter of cylinder in inches $= d$;
Pressure of steam in lbs. per square inch $= p$;
Number of revolutions of fly-wheel per minute $= n$;
Point of stroke at which steam is cut off $= x$;
then

$$\text{Actual H. P.} = \frac{d^2 \times \cdot7854 \times l \times 2n}{33000} \times$$

$$\text{P}x\ (2\cdot3 \log \tfrac{1}{x} + 1)$$

Thus if the length of stroke were 1 ft., diameter of cylinder 6 in., number of revolutions of fly-wheel per minute 100, pressure of steam 60 lbs., and the steam was cut off when the piston had moved through $\frac{3}{4}$ of its entire stroke, that is $x = \frac{3}{4}$, then

$$\textit{Actual}\ \text{H. P.} = \frac{36 \times \cdot7854 \times 1 \times 200}{33000} \times$$

$60 \times \frac{3}{4}\ (2\cdot3 \log \frac{4}{3} + 1) = 10$, very nearly.

The *nominal* horse-power of an engine is calculated from the formula

$$\text{Nominal H. P.} = \frac{d^2 \sqrt[3]{l}}{15\cdot6}$$

Taking the values we have given to d and l, we get

$$\textit{Nominal}\ \text{H. P.} = \frac{36 \times 1}{15\cdot6} = 2\cdot3,$$ which is very considerably less than the *actual* horse-power.

We cannot too strongly insist upon the necessity in all trials of the electric light of the *actual* or *indicated* horse-power of the engines being given and not the *nominal* horse-power; and we are inclined to think that if this was done, the results of some of the trials would be by no means so favourable to the light as one is led to suppose, although as regards the engines the results would prove highly creditable to the engine makers.

The engine of which we give an illustration, is manufactured and designed by Messrs. Robey & Co., of Lincoln. It is admirably adapted for driving the dynamo-machines, and is especially remarkable for the small space it occupies, its regularity of speed, large margin of power, and regularity in running; this latter point is especially valuable, as upon it depends very much the steadiness of the light.

The locomotive type of boiler employed enables about 20 per cent. more water per lb. of coal to be evaporated than would be the case in one of the Cornish or egg-ended form. There is no loss due to the leakage or radiation from steam pipe and other large surfaces. The boiler working with an artificially strong draught, an inferior, and therefore cheaper class of fuel can be used.

The engine parts are fitted up with all modern improvements, the cylinders are steam-jacketed, and the valve gear is arranged to work with variable degrees of expansion.

The result of the whole being an economy of fuel, as proved by actual comparison with the old type of engine doing the same work, of from 20 per cent. to 50 per cent.

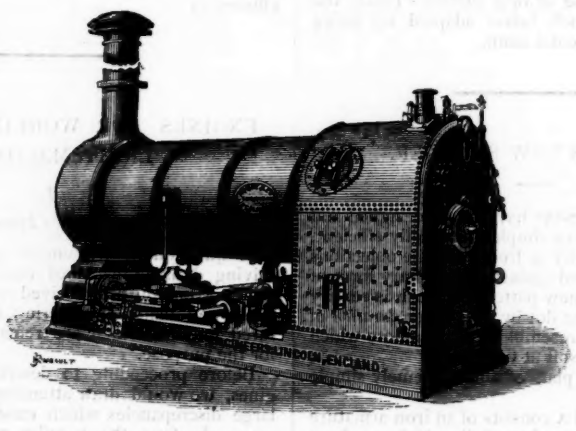
As will be seen, the entire engine is erected on a massive cast-iron bed-plate, so that the boiler is relieved of all strain due to the engine, and is confined to its legitimate purpose—that of raising steam.

The base-plate is formed at one end into an ash-pit, with damper doors, and is made suitable for receiving the fire-box end of the boiler—the other end of which is carried by a crutched-shaped casting fixed over the cylinders.

The end of the base-plate under the cylinder is formed into a feed water tank, into which the cylinder cocks discharge all condensed water, and into which a portion of the exhaust is so directed as to heat the feed water to nearly boiling point before going into the boiler.

The whole of the parts of both engine and boiler being included on one foundation or base-plate, heavy and expensive foundations are dispensed with—the weight of the boiler and its contained water acting as an extra weight to assist in keeping the whole machinery in rigid position.

The 16 "Jablochkoff" lights recently employed for lighting the Billingsgate Market were produced by a dynamo-machine, driven by one of Messrs.



Robey's 20 *nominal* horse-power engines; the boiler pressure being 60 to 80 lbs., the point of cut-off one-half, and the *indicated* horse-power 23.

It will be noticed that in this case, the indicated horse-power was but very little in excess of the nominal horse-power. The form of engine is capable, if necessary, of working up to 60 indicated horse-power.

Correspondence.

[We do not hold ourselves responsible for the opinions of our correspondents.]

CLERAC'S TUBE.

To the Editor of THE TELEGRAPHIC JOURNAL.

DEAR SIR,—Enclosed I send you official communications just received from the French Government relative to Clerac's Tube.

Sincerely yours,
3rd Feb., 1879. D. E. HUGHES.

"Paris, le 1er Février, 1879.

"MONSIEUR LE PROFESSEUR,—Conformément au désir que vous m'avez exprimé, je vous adresse ci-joint une série de documents établissant que les tubes de resistance ou rhéostats à charbon imaginés par Monsieur Clérac, remontent certainment à une date anterieure au 4 Mars, 1866.

"Recevez, Monsieur le Professeur, l'assurance de ma consideration tres distinguée,

"COCHERY,
"Le sous Secrétaire d'Eat des Finances.

"Monsieur le Professor Hughes,
"94, Great Portland Street, London, W."

The following is a translation of the above letter:—

"Paris, Feb. 1, 1879.

"MONSIEUR LE PROFESSOR,—Conformably to the desire that you have expressed to me, I send you herewith a series of documents establishing that the resistance tubes or carbon rheostats, invented by M. Clerac, go back certainly to a date anterior to the 4th March, 1866.

"Receive, M. le Professor, the assurance of my very distinguished consideration,

"COCHERY,
"The Under-Secretary of State for Finance.
"(Now Minister of Posts and Telegraphs.)

"Professor Hughes,
"94, Great Portland Street, London, W."

[Here follows the original letter from Professor Hughes to M. Clerac, respecting his tubes, which we published in the Correspondence of our last number. It bears the Paris postmark for March 10, 1866, on its back.—Ed. T. J.]

The other documents are:—

"Paris, January 27, 1879.

"MY dear M. Clerac,—It was in 1866 that I delivered to the Administration des Telegraphes the first Hughes' apparatus that I constructed. It was equally in the same year that I was nominated a member of the Comité de Perfectionnement de Lignes Télégraphiques, of which Professor Hughes was also a member. These dates make me absolutely certain that Prof. Hughes spoke about and described to me, either at the end of 1865 or in the beginning of 1866, your rheostat formed of powdered carbon or pulverised plumbago, which you mixed more or less with other substances, and which you compressed more or less I recollect perfectly this little tube which I held in my hands, and in answer to my question, 'Can this serve as a standard of resistance?' Professor Hughes replied that you had found that the conductivity was variable with the pressure. (M. Hughes m' a repondu que vous aviez reconnu que la conductibilite etait variable avec la pression.)

"All this, my dear M. Clerac, I recollect perfectly, and I attest it willingly to you by this letter, begging you to believe me,

"Votre plus devoué,
"E. HARDY,
"Ingenieur-Electrician.

"5, Avenue de la Motte Piquet, Paris."

"Paris, January 27, 1879.

"I, the undersigned, declare that I constructed in the course of the year 1873, with carbon, metallic, and other powders, agglomerated by means of fatty bodies, sundry resistance apparatus, which had for their starting point (qui avaient pour point de départ) the economical rheostats, formed of powdered carbon compressed in insulating tubes by regulating screws, invented anteriorily by M. Clerac.

"(Signed) BEAUFILS,
"Chemist, Chargé du Laboratoire à la Reception du Material."

"Paris, January 27th, 1879.

"L'Inspecteur-ingenieur, Chargé du Service de la Reception du Materiel des Telegraphes, certifies to having made use in 1873 for to establish leakages (etablir des derivation) on lines from Paris to Marseilles, some of the resistance apparatus which form the subject of M. Beaufils' certificate.

"(Signed) LAGARD."

"Paris, January 28th, 1879.

"The undersigned certify to having executed towards the end of the year 1865, and during the year 1866, according to the instructions of M. Clerac, and under his direction, certain rheostats of powdered charcoal and graphite, dried, and compressed in glass and wooden tubes by aid of a regulating screw, whose degree of pressure permitted the resistance to be varied.

"This work was done in the premises set apart for the course of instruction on the Hughes' apparatus at the seat of the Administration des Télégraphes, Paris. "(Signed)

"L. MANDROUX, L. RAULT, L. BARDEZ."

Agents speciaux des Telegraphes a l'Administration Telegraphique.

The following letters on the above subject have also been addressed to the TELEGRAPHIC JOURNAL.

SIR,—Prof. Barrett's arguments would be more readily understood as coming from a lawyer rather than from a man of science. He pretends that since I did not speak of the variation of resistance with difference of pressure, in my note of 1874, to the *Journal Telegraphique* of Berne, it was because I was ignorant of the phenomenon. To that the reply is easy: I had no call in a note of several lines to give the theory of my apparatus, but only to set right an allegation of M. Zetzsche who attributed that invention to a German. It will suffice to re-read my note and the article to which it replied for to convince any one that there was no need then either to describe the article or to give the theory of it.

If now any one examines my tubes, he will be led to ask himself why I employed pressure screws, if it was

not for the purpose of varying the compression of the powder until the resistance sought is obtained.

Further—and this is a criticism that I have myself addressed to my inventions since the beginning—as Prof. Hughes will be able to recall—the variations of temperature in dilating or in contracting the glass or wood, produced variations of the resistance of the powder; but it is not necessary to be *un grand savant* for to render an account of that phenomenon. These changes of resistance proceeded from a variable state of compression of the powder which was of necessity subjected to the mechanical action exerted by temperature on the tube which contained it. I have truly no merit in explaining this simple cause which has struck all those who have handled my tubes. I will add besides, that if it had been able to escape my own notice it would certainly not have escaped that of everybody else at that time.

I believe that it would not have said much for Prof. Barrett, supposing he had been in my place, if he had hesitated a single instant to recognise the cause whose effect he had thus ascertained. This being so, is it possible for any unbiassed mind to suppose that I could not then explain the action of pressure?

To sum up, in whatever manner I reason, I cannot find the least appearance of solidity in the arguments of Prof. Barrett, and it seems to me that it is only necessary to ask my tube itself in order that it should respond for me.

HIPPOLYTE CLERAC,
Inspecteur Ingenieur des Telegraphes.

Paris, Feb. 3, 1879.

Allow me, sir, some new reflections on the subject of the pretensions of Mr. Edison mentioned in the last letter of Professor Barrett.

Even admitting that the tubes of Clerac were not furnished with resistances variable with pressure, which is contrary to the opinion of all those who have had acquaintance with these tubes, it does not therefore follow that Mr. Edison made that discovery, even for carbonaceous powders. For here is what I have myself published on this subject in the *Comptes Rendus* of the Academy of Sciences for Dec. 2, 1872, in regard to the electric resistance of carbon powders and metallic filings:—

"The resistance of the middle medium with dry powder of wood charcoal was from 1,200 to 2,000 kilometres of telegraph line, and with metallic powders or retort carbon, from 1,200 to 2,000 metres, according to the more or less brilliant state of the surface of the metal grains and their degree of closeness (tassement) round the electrodes, &c."

For the rest I have been occupied with this question at four different times since 1856.

1. In 1856 I studied it from the point of view of the imperfect contact of the metallic studs of current interrupters (see my *Exposé des Applications de l'Electricité*, 2nd Edition, Vol. I., p. 246).

2. In 1864 I studied it from the point of view of the relative insulation of the spires of an electro-magnetic helix with bare wires (see my Memoirs on this subject in the *Annales Telegraphique*, Vol. VIII., p. 211, the numbers for March-April, 1865).

3. In 1872 I studied it from the point of view of the conductivity of semi-conductors (see the *Comptes Rendus*, Dec. 2, 1872).

4. In 1874 I studied it from the point of view of the application of electrodes on ligneous bodies (see my Memoirs in the *Comptes Rendus* for July 6, 1874, Aug. 10, 1874, Sept., 1874, and May 2, 1875).

Like Professor Barrett, I concluded that the effects determined by the pressure proceeded from a more intimate contact of the molecules of the bodies at the point of contact. The following is what I said, in fact in my note of July 6, 1874:—

"It is always the case that the conductivity is in ratio to the degree of pressure of the plates of communication. This last action evidently depends on the *greater or less intimacy of contact which is produced at the time between the two superposed surfaces.* For in substituting a drop of distilled water instead of the pressure, we immediately get, with the plate simply placed upon the table, the maximum of deviation, just as if these plates had been pressed by presses."

This question of indifferent contacts has engaged my attention during twenty years. I have even devoted a chapter to it in my *brochure* on the conductivity of semi-conductors, and Mr. Edison cannot honestly call himself the author of a discovery made when he was hardly six years of age. It is, therefore, not without a certain sentiment of regret that I see Mr. Edison, whom I was the first to herald into France, continue to sustain pretensions which cannot be sustained, and to put forward as his own an apparatus under the name of *Pressure Rheostat*, and which is only the Clerac Tube with a micrometer added. Such a course of action is unworthy of him.

Accept the expression of my best sentiments,

DU MONCEL.

MR. HERRING AND THE POST OFFICE.

SIR,—You are quite right in maintaining the necessity for a "third party to mediate between inventors and telegraph officials." The letter of your correspondent "M" simply furnishes additional reasons for such necessity. He ignores my complaint altogether, and because I have resolved not to submit any further invention to the telegraph department until the authorities have dealt with such complaint, he "deplores my apparent lack of practical familiarity with current telegraphic requirements," and asks me to "betake myself heart and soul to the improvement of sounders" in order to "win *his* admiration."

Pray allow me to inform your correspondent that an agreement exists between the Post Office and myself to refer the value of my invention to Sir William Thomson, Professor Fleeming Jenkin, Mr. Latimer Clark, and Mr. Forde, and that until those eminent gentlemen have been called together and all the facts necessary for a full and fair trial of my system have been submitted to them as the official referees, it is not my intention to hold any altercation with anonymous correspondents. At present the Post Office has broken faith with me upon all points. It promised that there should be a full and fair trial of my system. It invited me to make costly preparation for such trial. It induced me to engage and to pay two eminent scientific gentlemen to represent me at the trial. It arranged and signed terms of reference. It promised to adopt my system if the trial proved satisfactory. It obtained possession of my instruments under a written promise to proceed with the trial. It broke all those promises. It has given no reason for doing so. It has never appointed a meeting of the referees. It has not replied to my application to be reimbursed for the consequent loss of my time and my money. It has neglected to deal with my petition for redress although such petition has been referred to by the Crown. When your correspondent "M" can point with pride to an administration of the Government Telegraph Department of England in which such proceedings are impossible, he may then rely upon my hearty co-operation in every endeavour to improve telegraphy. As a matter of fact, however, I do not like the Morse system at all, and Sir William Thomson and Professor Jenkin in a recent report state:

"We are far from believing that the present Morse system can be regarded as final." This opinion is also shared by the highest authority on the working of land lines, Mr. Latimer Clark. Your correspondent "M," therefore, must be prepared for any difference of opinion which I may hereafter express as to the policy of extending the use of his favourite Morse sounder. Many telegrams contain the pith of private matters which the sounder discloses to waiting ears. Even the Morse transmitting key, in a quiet suburban office, gives no uncertain sound to a practised listener. I know several offices to which my remarks apply, where either under the pretence of waiting for an omnibus or preparing a telegram, secret information might readily be acquired either from a Morse key in sending or a Morse sounder in receiving.

RICHARD HERRING.

27, St. Mary's Road,
January 24, 1879.

[W. L., F. D. and F. J. S.—Your letters will appear in our next.—Ed. T. J.]

Notes.

SIEMENS' ELECTRIC LIGHT was tried at an oratorio in the Albert Hall on February 13th, with great success.

THE WALLACE-FARMER LAMP (supplied by the Anglo-American Light Company of Hatton Garden) has been tried with success at the P. and O. sheds of the Southampton Docks.

THE electric light has been discontinued at Billingsgate and at Westgate-on-Sea on the score of cost.

FOGS AND THE ELECTRIC LIGHT.—During a recent snowstorm in Paris the Jablochkoff candles in the Avenue de l'Opera were lit and the darkness dispelled by the reflection of the electric beams from the snowflakes. The occasion of a fog is also awaited to try their illuminating effect. If it is successful, that is if the light will penetrate the fog for 20 metres, Jablochkoff lamps will be established at the busiest points of the city. Fogs are a somewhat rarer and less violent phenomena in Paris than in London, yet we have had no attempt made to lighten their darkness here, notwithstanding the fact that the mere starting of the machine gives the light.

AT the Physical Society on Feb. 8, Mr. Shoolbred gave an account of all the machines and lamps used in electric lighting. With regard to the De Mersaune regulator, which works mechanically by bevelled gearing, he said that it had been highly spoken of at the Paris Exhibition. The Wallace-Farmer light, though lasting was unsteady, perhaps because only natural gas carbon had as yet been used. With regard to the cost of Jablochkoff's system, experiments in Paris had shown that whereas the other lamps cost only 5d. per light per hour, Jablochkoff's cost 10d. per light per hour. The De Méritens candle was also shown. It consists of three upright parallel sticks of carbon, the outer two being the electrodes, while the middle one forms a stepping stone to the arc between them. After alluding to the fact that the positive upper carbon assumes a crater form which reflects the light down in such a way that the line of maximum intensity of light slopes downwards at an angle of 60° from the vertical axis of the carbons, Mr. Shoolbred pointed out that by placing the upper carbon a little behind the lower, Mr. Douglas had raised the line in question to horizontality. He also stated that in Paris the Jablochkoff light waned longer than it waxed, whereas in London it waxed longer than it waned, and suggested that the cause might reside in the fact that the London engines work more nearly at the speed of the machines, and the machines themselves are founded on stone and not wood as in Paris. Mr. Werdermann said that all carbon lights were partly due to the arc and partly to incandescence; his own lamp giving an arc as well as the others. The size of this arc could be regulated by pressure between the electrodes. He also stated that he hoped to show ere long that it was as easy to produce 500 currents as 10 from a single current, and observed that the size of the carbons greatly altered the intensity of the light. Professor Ayrton said that the difficulty of subdividing the light was not an electrical one, but lay in the fact that the amount of light produced is not in proportion to the amount of heat produced. In contradiction to Professor Ayrton, Mr. Werdermann maintained that the opposing electromotive force in the voltaic arc was directly proportional to the original electro-motive force. Professor S. P. Thomson pointed out that residual magnetism in the cores of the electro-magnets of machines lowered their efficiency, and hence short cores as in the Wallace-Farmer machine were advantageous.

DURING the four months from the beginning of October to the end of January last some eighty British patents have been taken out for electric lighting. It is a remarkable fact that the rush for patents which languished about Christmas time has begun again with renewed vigour; the obvious deduction being that plum-pudding is inimical to invention.

EDISON'S FOREIGN SPECIFICATION was published in extenso in the *Standard* for February 10th, but without diagrams. It describes a means of generating vibratory currents for the electric light by the vibration of magnetic rods in front of bobbins, a commutator being used to make the alternating current continuous if necessary. The mutual reaction principle may be applied herein if the rods are electro-magnets. The electro-pyres or metal burners are strips, rods, and beads of platinum, iridium, ruthinum, rhodium, ozmium, titanium, &c., oxide of titanium and other conducting oxides, silicon, boron, &c. The intensity of the light is regulated by the expansion of the electro-pyre from heating. This expansion operates a spring lever which throws in a shunt of wire, or one of carbon whose resistance varies with the degree of expansion of the electro-pyre. The expansion of gas heated by the electro-pyre is also used as a regulator. Secondary batteries giving a continuous current from a discontinuous one are also employed. The patent, whether practicable or not, displays Mr. Edison's accustomed ingenuity.

THE TELEPHONE.—We have received the first number of Vol. II. of the *Telephone Journal*, published in Chicago. It is the organ of the Bell telephone in Illinois, being devoted to the propagation of the Bell telephone, and is, in short, a trade circular in the guise of a paper. The striking feature in it is the list of subscribers to the "Telephone Exchanges" of Chicago and Louisville, who are connected by telephone through a central office. The list for Chicago actually forms a business directory, numbering over 600 names of the principal firms, offices, hotels, clubs, and shops in the city, giving over 5,000 calls daily; yet it is only six months since the Exchange was started. This truly

American go-aheadness is astounding compared to the slow progress of the telephone in England; but let us hope it will be stimulating. These Telephonic Exchanges are being rapidly introduced into all the large American cities from New York, which has already 750 subscribers, down to Detroit, which has only 150. There are actually 17,500 instruments in use, and of these some 15,000 are rented. The suit brought by the Bell Company against the Gold and Stock will probably come on for trial in April or May. The plea of the latter is that Gray invented the telephone prior to Bell.

THE MICROPHONE, as we have before stated, has been successfully applied by Professor Rosetti to the detection of minute seismic vibrations at Vesuvius and on the Solfatara of Possuoli. The subterranean noises heard by means of the microphone are classed by Professor Rosetti as rumblings, musketry reports, and metallic or bell-like sounds. A comparison of these microphonic sounds with the motions of the seismograph in Professor Palmieri's observatory at Vesuvius shows that the rumbling sounds correspond to undulatory motions, and the cracks to perpendicular motions. Being far more sensitive than the seismograph, the microphone reveals earth tremblings which otherwise cannot be noted. At Rocca di Papa on the Alban Hills Professor Rosetti could hear the characteristic seismic noises in the crater of an extinct volcano.

DR. BLECKRODE has observed that a microphone through which a strong current is passed emits a sound. He attributes the latter to the electro-dynamical action of the current on its movable part. M. Julius, of Breda, Holland, as it will be remembered, referred the microphonic action to dilatation of the carbon points through increase of temperature, while Mr. Varley has attributed it to a small cloud of carbon dust, or voltaic arc between the points.

COWPER'S TELEGRAPHIC PEN will be described to the Society of Telegraph Engineers at the next meeting on February 26th.

THE TELECTROSCOPE is the name given to a plan of M. Senlecq, of Ardres, France, for telegraphing the images produced in a camera. The device consists in an autographic telegraph similar to D'Arlincourt's, but the sending pencil is of selenium, which, as is well known, varies in electric resistance with the degree of intensity of the light falling onit. This pencil is connected up to the battery and line in such a way that as it crosses the surface of the glass plate on which the image is focussed in the camera it receives more or less light according to the shading of the image. These gradations of light are attended by corresponding gradations in the line current, and by means of an electro-magnet at the receiving end these variations of current are caused to produce a greater or less pressure of the marking crayon on the paper there. The plan exists as yet in idea; but like M. C. Borseuil's imaginary telephone, it is worthy of record as the first attempt to transmit photographic images by electricity.

WE are informed that Major Webber, R.E., and Mr. C. E. Spagnoletti, C.E., the former being vice-president of class 65, and the latter supplementary juror of group 6 (Electrical section) at the Universal Exhibition, Paris, last year, have had the honour of being presented with a proof portrait of H.R.H. the Prince of Wales, accompanied by a gracious letter of thanks for their services from His Royal Highness as a personal mark of their connection in the work of the Paris Exhibition.

A DUPLICATE TRANS-AUSTRALIA LINE is proposed.

WE have received the report of the American Telegraphers' Mutual Benefit Association, New York, President, J. D. Reid, from which it appears that notwithstanding the severe drain on the society, caused by the yellow fever epidemic, there is a handsome balance for the year.

THE Direct United States Cable broke down on Jan. 4. The *Minia* is out on the repairs near Torbay.

IN the new French governmental arrangements M. Cochery has been appointed minister of Posts and Telegraphs.

SIR CHARLES WHEATSTONE'S PAPERS.—The Physical Society's reprint of Sir Charles Wheatstone's papers will be ready in a few days.

WE have received the Journal of the Melbourne Electrical Society for May-October, 1878. The society, which has been in existence four years, now numbers over 100 members, including ladies.

UNDERGROUND LINES IN PHILADELPHIA.—In 1877 several underground lines were laid in Philadelphia after a plan of Mr. David Brooks, and in connection with the working of the city railways. One of these lines crossed the Schuykill river. The line consists in cotton-covered copper wires laid together into cables and pulled through iron pipes, which are then filled with paraffin oil. In this way fifty No. 18 copper wires are easily drawn into a pipe 1 inch in diameter. The most convenient length for drawing in and splicing is 1,000 feet. The oil solidifies at 20° below zero F. The insulation is 2,500 megohms per mile at 40° F. The system, which is specially useful for telephone circuits, has been patented in all foreign countries, and a company has been formed to work it under the title of the "Brooks Underground Telegraph Construction Company, Limited," Philadelphia.

WE have received the following small drama from our facetious correspondent *Will-o'-the-Wisp*.

THE INVENTOR AND THE OFFICIAL.

SCENE.—The general Post Office, St. Martins-le-Grand.

BRITISH TELEGRAPH OFFICIAL discovered at his desk.

Enter an OLD INVENTOR.

B. T. O. *(Warmly.)* "How do you do, Mr. Crazytop? Delighted to see you. I haven't seen you for an age."

O. I. *(Humbly.)* "Pretty well, thank you. I've been very busy lately. I've got something good here to show you; a fine idea; save no end of money. I patented it a year ago, and I've been at work on it ever since."

B. T. O. *(Warmly.)* "Oh, indeed; I'm very glad to hear it. You know we are always ready to welcome any new thing."

O. I. "Especially if it's American."

B. T. O. "Hum. Let us see this instrument."

O. I. "There she is." [*Explains its merits.*] "You see that it will be a great saving to the service."

B. T. O. *(Warmly.)* "Well, we'll have it tried, Mr. Crazytop."

O. I. *(Humbly.)* "If you please, I should like to experiment with it a little while myself on a real line, so as to improve and perfect it. Of course I have no telegraph line in my house, and I must come to you for one."

B. T. O. *(Warmly.)* "By all means, Mr. Crazytop, if you pay for it."

O. I. *(Gloomily.)* "I can't pay for it."

B. T. O. *(Warmly.)* "Well, good-bye, Mr. Crazytop, I shan't see you for some time; I'm going to have a trip in America on behalf of Government, to see if I can't pick up some novelties, and introduce them here."

O. I. *(Abstractedly.)* "Ah! I daresay you'll enjoy that. Good-day."

B. T. O. *(Warmly.)* "Good-bye, Mr. Crazytop, good-bye. (*Aside.*) Confound the man, he's a perfect nuisance."

DR. BURDON SANDERSON'S investigations on the exceptional property possessed by the leaves and other organs of certain plants of exhibiting definite movements in response to mechanical, chemical, and electrical stimuli, have led him to the conclusion that the exciting process in plants is similar to that which takes place in animal tissues when they are stimulated in the same way.

Proceedings of Societies.

PHYSICAL SOCIETY.

AT the meeting of this society on Jan. 25, DR. ERCK exhibited a constant bichromate of potash cell consisting of a narrow lead trough, 12 ins. long by 3 ins. wide, by 1 in. deep, lined along both sides internally with carbon plates. The zinc plate, 10 ins. long, is immersed in the solution to the depth of an inch midway between the carbons. A circulation is maintained by allowing fresh solution to drop into the cell at one end, and the old to drop away at the other. As the space between the two carbons is only half-an-inch, the internal resistance of the cell is only about ¼ ohm on short circuit. To obtain the maximum current, 8 ozs. of solution is supplied per hour. This battery is used by Dr. Erck to drive a small astronomical clock. Dr. Erck also showed a battery composed of carbon and zinc plates mounted on an axle rotated by wheel work.

Messrs. Elliott Bros., exhibited sundry novel commutators.

At the meeting on Feb. 8, DR. O. J. LODGE read a paper on the thermal conductivity of a rod, and Mr. SHOOLBRED discoursed on the Electric Light (see our Notes under this head).

THE SOCIETY OF TELEGRAPH ENGINEERS.

AT the meeting of this Society on February 12, MR. WILLOUGHBY SMITH read a paper on the "Working of Long Submarine Cables," and Mr. C. F. Varley opened the discussion.

New Patents—1879.

4. "An improved mode of and means for obtaining writings and designs for printing and other purposes by means of electricity." ALEXANDER BROWN (communicated by Gabriel Phillipe Loriss Bellet and C. H. O. Hallez d'Arros, Paris). Dated Jan. 1.

27. "Improvements in apparatus for producing electric light." B. A. RAWORTH. Dated Jan. 3.

58. "Improvement of galvanic cells and batteries." W. ERCK. Dated Jan. 6.

60. "Improvements in telephonic apparatus." JOHN IMRAY (communicated by M. Boudet, Paris). Dated Jan. 6.

65. "Improvements in electric lamps." A. M. CLARK (communicated by E. Ducretet, Paris). Dated Jan. 6.

83. "Improvements in electric lamps." W. LADD (communicated by J. Jaspar of Liege). Dated Jan. 8.

153. "Improved instrument or means to be employed in illuminating and examining internal parts or cavities of the human or animal body." (Communicated by M. C. F. Nitze, Vienna.) Dated Jan. 14.

178. "Improved means for obtaining light by electricity." A. DE MÉRITENS, Paris. Dated Jan. 15.

192. "An improved method of and apparatus for preventing rapid combustion or destruction of the electrodes used in electric lighting. G. REMINGTON. Dated Jan. 16.

229. "Improvements in telephones. W. R. LAKE (communicated by F. Blake, Jr., Weston, Mass., U.S). Dated Jan. 20.

245. "Improvements in apparatus employed in electric lighting." R. E. B. CROMPTON and P. W. WILLANS. Dated Jan. 21.

259. "An improved lamp or apparatus for shading the electric and other lights, and for producing various effects of light for scenic and other purposes." T. W. GRIEVE. Dated Jan. 22.

277. "A new or improved electrode or electric candle for the purpose of lighting by electricity, and effecting the divisibility of the electric light." SIGISMUND COHNÉ. Dated Jan. 22.

299. "Improvements in apparatus for producing light by electricity and other means." H. J. HADDAN (communicated by E. Molerd and J. Celrian, San Francisco). Dated Jan. 24.

307. "Improvements in and relating to insulated wires and cables, and in the method of insulating, fixing, and laying the same for telegraphic and other purposes," W. MOSELEY. Dated Jan. 24.

325. "Improvement in electric light apparatus." E. L. PARAIRE. Dated Jan. 27.

332. "Improved means of obtaining currents of electricity." BARON ELPHINSTONE, C. W. VINCENT. Dated Jan. 27.

338. "Improvements applicable to submarine telegraphy." A. M. CLARK (communicated by F. J. F. Ailhand, Paris). Dated Jan. 27.

359. "Improvements in electro-metallurgy and their application." H. BRITTAIN. Dated Jan. 29.

371. "Improvements in magnetic appliances and garments." L. M. BECKER. Dated Jan. 29.

389. "Improvements in and relating to reflectors for electric-lighting apparatus." W. R. LAKE (communicated by E. B. Watson, Yokohama). Dated Jan. 30.

390. "An improved protecting coating for ships, telegraph cables, and other structures or materials." G. WATSON. Dated Jan. 30.

394. "Improvements in telephones." J. H. JOHNSON (communicated by F. A. Gower and C. Roosevelt, Paris). Dated Jan. 30.

416. "Improvement in electric lamps." J. D. F. ANDREWS. Dated Feb. 1.

427. "Improvements in electric lamps." Dated Feb. 3.

454. "Improvements in means and appliances for electric lighting." R. W. H. P. HIGGS. Dated Feb. 15.

465. "Improvements in buoys exhibiting electric light, and in batteries for generating electricity for this and other purposes." S. W. M. DE SUSSEX. Dated Feb. 5.

477. "Improvement in galvanic batteries." T. SLATER. Dated Feb. 6.

ABSTRACTS OF PUBLISHED SPECIFICATIONS—1878.

1779. "Improvements in speaking telephones and in apparatus connected therewith." J. F. BAILEY (communicated by G. M. Phelps, New York). Dated May 2. 8d. This describes forms of Bell telephone having more than one coil and plate, dampers to the plate, plates divided into two or more vibrating areas combined with two or more coils and cores, vocalising chambers in combination with the plates, telephones with two parallel vibrating diaphragms, and an arrangement of telephone calls, &c.

1783. "Electro-pneumatic bell indicators." J. W EDMUNDSON. Dated May 3. 2d. A pendulum is set swinging either by a pneumatic or electro-magnetic signal. The swinging of the pendulum tells the attendant whence the signal came. *Not proceeded with.*

1882. "Telephones." J. F. BAILEY (communicated by G. Gray, Chicago). Dated May 10. 6d. This describes several forms of Bell telephone in which two or more simple telephones are clustered together.

1889. "Lighting gas jets by electricity." A. R. MOLISON. Dated May 10. 2d. This consists in causing a platinum wire or piece of spongy platinum to be gently heated by the current, and then allowing the gas to impinge upon it so as to intensify the heating thus begun by catalysis. *Not proceeded with.*

1917. "Transmitting and receiving electrical and telephonic excitations." A. S. HICKLEY. Dated May 13. 6d. This consists in using a diaphragm radially magnetised; or of polarised rings in sections, united by a dia-magnetic metal; and of attaching the string telephone to the diaphragms of electro-magnetic telephones in such a way that from one string mouthpiece several telephones may be operated.

1927. "Electric apparatus." P. JENSEN (communicated by A. J. B. Cance, Paris). Dated May 14. 6d. This consists in forming electro-magnets, for motors, and dynamo-machines, by building them up in concentric layers of wire and soft iron rod-cores. New forms of bent armatures and commutators are also set forth.

1937. "Coating telegraph wires." W. ABBOTT. Dated May 15. 2d. This consists in insulating wires with cotton steeped in the residuum from the manufacture of ozokerit, applied hot, and with or without any other insulating material. *Not proceeded with.*

General Science.

LIGHT AND COLOUR SENSATIONS.—M. Aug. Charpentier and Dr. Lanholt have come to the conclusion, from recent experiments communicated by them to the French Academy of Sciences, that the sensations of light and colour are the results of two distinct functions, which, although they are intimately blended in the habitual use of vision, may be clearly distinguished from each other by physiological analysis. By experiments with lenses they found that the sensibility of the eye to light was much greater when the eye is at rest in darkness than when it is in activity. There was, however, no such difference noticeable in the sensibility to colour. M. Charpentier thinks that the explanation of this fact is to be found in the discovery by Ball and Rühne of a reddish chemical substance in the retina, which is discoloured by light, and which is renewed by darkness. If we admit, as seems probable, that the optic nerve is excited not directly by light, but indirectly by the chemical modification which the light produces in the retinal red, the superior sensibility of the eye in repose may be explained by the excess of the photo-chemical substance which the eye has acquired under the influence of darkness.

AN IRON MOUNTAIN.—The Cerro de Mercado, a Mexican mountain, supposed by Humboldt to be an immense ærolite, has recently been explored by Senor Weidner, who found the hill to be deficient in the chemical constituents of meteorides—namely, iron, nickel, and cobalt, in a native or malleable state; but, on the contrary, to be largely composed of crystalline, magnetic iron, and various oxides of that metal.

FLOW OF RIVERS.—The commonly received theory of the flow of water in streams ascribes a gradually diminishing mean velocity to successive layers of water from the surface of the stream down to the bottom. Prof. James Thomson, of Glasgow, sees reason to doubt the truth of this view, and puts forward the theory that the accelerated surface water tends to sink, while the friction-retarded bottom water tends to rise and mix itself with the surface water, where it receives acceleration from gravity in running down hill.

MESQUITE.—The honey mesquite (*Algarobia glandulosa*) is one of the principal forest trees in Texas. It is a short spreading tree resembling an apple tree, and attains a trunk diameter of eighteen inches. It belongs to the leguminous family, and bears pods nine or ten inches long, containing beans enclosed in a sweet pulp like that of the honey locust. Both beans and pulp are eaten by the Indians, and sometimes by white men, though they are chiefly given as fodder to horses. It is allied to the lignum vitæ, and resembles it in hardness and durability. Fences of this timber in Southern Texas have been known to last fifty years. The poles of the military telegraph in Texas are made of it.

SEBASTINE is an explosive made in Stockholm by a company. It is a compound of nitro-glycerine, wood charcoal, and certain explosive salts. Ignited by fire sebastine burns readily, but does not explode. If confined in detonating capsules, like dynamite, it explodes with great violence. Its merit consists in its being safer than other nitro-glycerine preparations, from the fact that its mass is dryer, and the explosive oil does not escape. It is also more powerful and rapid than ordinary dynamite No. 1 (containing 75 per cent. of nitro-glycerine). Sebastine was patented in Sweden in 1872, and although the yearly output is now 60,000 kilogrammes, no accident has occurred from it during the five years it has been in use.

NOBEL'S EXPLOSIVE GUM.—Recent experiments with this new explosive at the St. Gotthard Tunnel, prove it to be of double the exploding power of dynamite. It has also the advantage over the latter of keeping for an indefinite time under water without deteriorating, an important quality in torpedo work. Camphor added fits it for gunnery.

A NEW ANÆSTHETIC.—M. P. Bert has discovered that a mixture of equal volumes of nitrous oxide and atmospheric air administered to the patient at a pressure of two atmospheres, operates as a harmless anæsthetic which produces long intervals of insensibility.

City Notes.

Old Broad Street, Feb. 12, 1879.

THE ordinary general meeting of the proprietors of the Eastern Telegraph, Limited, was held on the 30th ult. at the City Terminus Hotel, under the presidency of Mr. J. Pender, M.P. The chairman moved the adoption of the report, an abstract of which will be found in our last issue. The Marquis of Tweeddale seconded the motion.—A Shareholder complained of the increased capital, and thought that some effort should be made to stop further increase in the future.—Mr. Barum called attention to the fact that whilst their receipts were decreasing the expenditure was increasing.—The chairman, in answer to questions, said that there could not be progress without capital, and of late years their progress had been remarkable. One of the great disadvantages under which they laboured was the codification of messages, by which two or three words were made to represent a great many. The Cyprus cable, which had cost the company £30,000, had earned at the rate of £5,000 a year.—The report was adopted with three dissentients.—Upon the re-election of the Marquis of Tweeddale being put to the meeting, the resolution was negatived by a majority, upon which a poll was demanded.—Mr. William N. Massey, M.P., having been re-elected to a seat at the board, and the retiring auditors having been also re-elected, the proceedings closed in the usual manner.—The result of the poll was in favour of the re-election of Lord Tweeddale.

The half yearly meeting of the shareholders of the Anglo-American Telegraph Company was held on the 10th inst., under the presidency of Viscount Monck. The chairman in moving the adoption of the report (of which an abstract appeared in our last issue) said, "From different causes they had been obliged from time to time to change the tariffs at which they carried messages to America, and that change rendered every comparison between any two periods useless. They had now, however, been working for nearly two years at a uniform tariff, and from the best opinions they could form in regard to the figures of the three half-years, they found that their revenue showed an increase of from 5 to 7 per cent. That was encouraging in itself, and more encouraging when they considered the depression of trade which had existed during the past two or three years, and he thought they might reckon that the 5 or 7 per cent. would be largely increased in the future, when the existing depression should have passed away. In the report the board alluded to the failure of the expedition to repair the 1866 cable; that was put into the report merely *pro formâ* because, although the fact was mentioned at the last meeting, they were unable to put it in the report. The failure was no doubt a strong warning to them in reference to laying by an adequate sum for renewal fund. The directors had laid by what they considered an adequate sum and they were glad to have been able to do so without reducing their dividend to an extent which would be excessive. He hoped that the time would come when the normal increase of traffic would enable them to pay a much larger dividend. There was one point to which he would direct attention, because it was a new source of expenditure—the superannuation fund for retiring officers. It might be well argued on general principles that it was the duty of every man to provide out of his income for his old age or a provision for his family; that, no doubt, was sound reasoning, but, unfortunately, it would be found in practice that, taking all the great employers of labour, from the State downwards, it had been deemed necessary to make some provision independently of the man's own exertions for his old age or for his forced retirement in consequence of illness or other cause. If such a provision were not made, they would have from time to time cases of absolute misery coming before the directors, which human nature would be utterly unable to resist, and provision would thus have to be made out of the funds in a fragmentary manner instead of systematically. That was the reason which induced the State to provide a superannuation for its servants, and it was found to operate exceedingly well, because it gave them a strong hold over their servants during their period of service. There was a particular reason in this company why such a fund should be established, owing to the nature of the occupation. The mirror system of telegraphy was very trying to the sight, and after some years the men who worked it frequently became altogether unable to earn their living in any other way. The board proposed that the funds of the company should be charged with only one-half of the superannuation fund, the officers themselves being called upon to provide the other half. In reference to the proposed new company, which it was said was starting in opposition to them, he said that the proprietors had no doubt seen a statement in a City article in reference to this matter; but he thought that article had been written with the view of what was called forcing the directors' hands at that meeting. The caution money of the company had not been paid as stated. The directors were fully alive to the importance of any attempt of that kind. They were taking every means in their power to protect their interests, and he trusted the shareholders would have sufficient confidence in the directors to leave the matter in their hands, and not play into the hands of the enemy by forcing them into premature disclosures. In conclusion, he congratulated the proprietors on the growing prosperity of the company. The cables were working well. The French cables had been ten years in the water, and were still working well, and he trusted that the prosperity of the company would not be interfered with. The motion having been seconded, in answer to a proprietor, the chairman stated that the board proposed to place £2,000 a year to the superannuation fund.—Mr. Jackson, whilst generally congratulating the proprietors upon the condition of the company, criticised the expenditure and advocated a reduction. He also, whilst admitting the principle of establishing a superannuation fund, expressed an opinion that they were not yet in a sufficiently prosperous condition to carry out the suggestion.—After some further discussion, the chairman, in reply, as an argument in favour of the superannuation fund, pointed to the confidential nature of the work in which they were engaged, and its deteriorating effect upon the sight. The board endeavoured, as far as possible, to curtail the expenditure, but not at the expense of efficiency. No stone would be left unturned in order to find the most durable cable for their purpose. As to the duplex cable, if they used the patent it would cost them £1,500 a year. They had been experimenting with the duplex, and had found that by it they could get 90 per cent. more work out of the cable, and if it proved a success, £1,500 a year would not be a large amount to pay. The report was adopted, and the dividends therein recommended declared. The resolution relative to the superannuation fund was met by an amendment to the effect that the matter should be postponed for six months, which, upon being put to show of hands, was carried. A poll was demanded, the chairman stating that the board held proxies to the extent of £3,000,000 in favour of the resolution. The amendment was ultimately withdrawn, upon the understanding that the matter should be again brought forward at the next meeting.

At the sixth ordinary general meeting of the

Western Brazilian Telegraph Company (Limited) Mr. Henry Rawson presiding, the chairman, in moving the adoption of the report, of which an abstract appeared in our issue of Feb. 1st, said the directors had tried to the utmost to carry on the affairs of the Company, and if they had failed in securing a good profit last year, it was from no fault of their own, but from circumstances over which they had not, and could not possibly have, any control. He then referred to the stagnation in commercial affairs, and the difficulties against which they had had to contend through the numerous interruptions of their cables and other misfortunes. During the last twelve months they had relaid 830 miles of their cables, 730 of which were entirely new sheathed, and it had all been done with from £24,000 to £25,000 supplied by the shareholders. When he told them that 830 miles formed a third of their entire system, and that the whole of their system had cost them £1,700,000, they could not say that on this occasion they had not done the work most economically. It was very satisfactory to know that in the deep water they found that the original cable was very good. During the next year he thought they might hope to earn as good a revenue as could be earned from their lines. With respect to their capital account, they had made a debit of £70,000 for laying the cable into Maranham, according to the terms of the concession. If they had had a better revenue account he would have preferred to put the whole of this to that account, although it actually belonged to capital account. The motion having been seconded, the chairman, in reply to a question, said they had tested their cables to a very great extent, and found them better than they expected they were twelve months ago. In twelve months' time they hoped to be out of debt and difficulty. The report was then adopted.

The ordinary general meeting of the shareholders of the Submarine Telegraph Company was held on the 11th inst. at the City Terminus Hotel, Cannon Street, under the presidency of Sir James Carmichael, Bart. The report stated that the accounts for the six months ending December 31st, 1878, showed an increase over the corresponding half year in 1877, and the directors were consequently enabled, after adding the usual proportion of the receipts to the reserve fund, to recommend a dividend at the rate of 17½ per cent. per annum. The lease of the Company's offices in Threadneedle Street, which was held under Government, would expire in June, 1880, and as additional accommodation was required in the building for the exclusive use of the Post Office, her Majesty's Postmaster-General had given notice to the directors that he would be unable to extend the Company's lease beyond its present term. The board had consequently obtained an eligible site in Throgmorton Avenue, on a lease for 80 years, and had entered into a contract with Messrs. Peto Brothers for the erection of new offices for the sum of £16,229. The Chairman moved the adoption of the report. Sir Thomas Dakin seconded the motion. The report was adopted without discussion, and the dividend therein recommended declared, after which resolutions were adopted unanimously, authorising the directors to apply for a supplemental charter, giving the Company power to purchase the land and erect their offices, and also to use a portion of the reserve fund of the Company for that purpose.

The report of the India-rubber, Gutta-percha, and Telegraph Works Company (Limited) states that, after all working expenses and depreciations and providing for bad debts, the net profit for the year is £43,463. Adding £18,950 brought forward from 1877, and deducting £2,514 written off shares held by the Company, and £11,750 interim dividend paid in August, there remains a disposable balance of £48,148. Of this the directors have set aside £25,000 to the credit of a reserve fund, and they recommended the distribution of £14,100 in dividend for the last half-year, being at the rate of 10 per cent. per annum, free of income tax carrying forward £9,048 to the credit of the current year.

The report of the Cuba Submarine Telegraph Company (Limited) to be presented at the meeting on the 19th inst., has been issued. From this it appears that the gross receipts for the half year, including the balance brought from last account, amount to £16,106, and the expenses to £4,253, leaving a sum of £11,853. The balance, after providing for the preference dividend, would admit, under ordinary circumstances, of a dividend on the ordinary shares at the same rate as that declared for the corresponding period of last year. The directors regret, however, to report that the Company's original gutta-percha cable broke down in the month of September last, and that there are signs of a fault in the new india-rubber cable. Mr. Keith, the Company's manager in Cuba, is now engaged in the repair of the original cable, and when that is completed (of which intelligence may arrive at any time) he will proceed to the repair of the new cable. Under these circumstances, and having regard to the necessary outlay on these repairs, which cannot be accurately estimated at present, the directors do not think it prudent to recommend a larger dividend than 6 per cent. on the ordinary shares. After payment of the dividend of 10 per cent. on the preference and that of 6 per cent. on the ordinary shares, there will remain the sum of £4,053 to be carried forward. The directors report that in consequence of the final suppression of the rebellion in Cuba, the land lines of the Spanish Government are now competing with the company's line. A falling off in local business may therefore be looked for in future.

The Eastern Telegraph Company notifies the extension of its lines in Cyprus, from Larnaca to Nicosia and Limasol, with a uniform tariff to all places in the island.

The following are the latest quotations of telegraphs:—Anglo-American, Limited, 59½-60¼; Ditto, Preferred, 86-87; Ditto, Deferred, 34¼-34¾; Black Sea, Limited, —; Brazilian Submarine, Limited, 6⅛-6⅞; Cuba, Limited, 8½-9; Cuba, Limited, 10 per cent. Preference, 15½-16; Direct Spanish, Limited, 1½-2; Direct Spanish, 10 per cent. Preference, 10-10½; Direct United States Cable, Limited, 1877, 11⅜-11⅝; Eastern, Limited, 7¼-7½; Eastern, 6 per cent. Debentures repayable October, 1883, 104-107; Eastern 5 per cent. Debentures repayable August, 1887, 100-103; Eastern, 6 per cent. Preference, 11¼-11½; Eastern Extension, Australasian and China Limited, 7⅛-7⅜; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 105-108; German Union Telegraph and Trust, 7½-8; Globe Telegraph and Trust, Limited, 5-5½; Globe, 6 per cent. Preference, 10½-10¾; Great Northern, 7½-8; Indo-European, Limited, 20-21; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 9-9½; Reuter's, Limited, 10-11; Submarine, 220-230; Submarine Scrip, 1⅞-2⅛; West India and Panama, Limited, 1¾-2⅛; Ditto, 6 per cent. First Preference, 8¼-8¾; Ditto, ditto, Second Preference, 7¾-8¼; Western and Brazilian, Limited, 2⅛-3⅜; Ditto, 6 per cent. Debentures "A," 85-90, Ditto, ditto, ditto, "B," 80-85; Western Union of U.S. 7 per cent., 1 Mortgage (Building) Bonds, 114-118; Ditto, 6 per cent. Sterling Bonds, 101-103; Telegraph Construction and Maintenance, Limited, 31-32; Ditto, 6 per cent. Bonds, —; Ditto, Second Bonus Trust Certificates, 2⅛-2⅜; India Rubber Co., 10⅞-11¼.